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The Pittsburgh Air Pollution Episode of November 17-21 1975: Air Quality

Health Effects Research Lab, Research Triangle Park, N C

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Environmental Health Effects Research Series

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16. ABSTRACT

In November 1975 a serious air stagnation problem developed over Western Pennsylvania, with extremely heavy air pollution in the Pittsburgh area. The U.S. Environmental Protection Agency's Health Effects Research Laboratory (HERL) ~~immediately~~ mobilized a team of air monitoring and epidemiological personnel to verify the nature of pollutants and to determine the possible health effects from this pollution. By Wednesday, November 19, pollution levels reached emergency stage, as determined by the standards of the Allegheny County Health Department, with particulate concentrations measuring 7.0 COH/1000 ft. for a 24-hr. average. HERL sent an EPA Community Health Air Monitoring Program (CHAMP) mobile monitoring laboratory van from Research Triangle Park North Carolina to provide independent verification of the Allegheny County monitoring data. School children were tested for pulmonary function near the site of monitoring facilities. This report describes and discusses EPA's monitoring effort during and after the pollution alert. It concludes that HERL's monitoring confirmed data collected by the local health department, that air stagnations such as this one are likely to recur, that different pollutants do not increase uniformly during an air inversion, and that Benzo-Alpha-Pyrene and suspended sulfates significantly contributed to the pollution problem. This report includes tables and figures on relevant data gathered regarding the episode, illustrations, and a map showing monitoring sites.

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THE PITTSBURGH AIR POLLUTION EPISODE OF NOVEMBER 17-21, 1975: AIR QUALITY

by

Douglas W. Baty
Jose M. Sune
David O. Hinton
Exposure Assessment Branch
Population Studies Division
Health Effects Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, N.C. 27711

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
HEALTH EFFECTS RESEARCH LABORATORY
RESEARCH TRIANGLE PARK, N.C. 27711

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This report has been reviewed by the Health Effects Research Laboratory, U.S. Environmental Protection Agency, and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

The many benefits of our modern, developing, industrial society are accompanied by certain hazards. Careful assessment of the relative risk of existing and new man-made environmental hazards is necessary for the establishment of sound regulatory policy. These regulations serve to enhance the quality of our environment in order to promote the public health and welfare and the productive capacity of our Nation's population.

The Health Effects Research Laboratory, Research Triangle Park, conducts a coordinated environmental health research program in toxicology, epidemiology, and clinical studies using human volunteer subjects. These studies address problems in air pollution, non-ionizing radiation, environmental carcinogensis and the toxicology of pesticides as well as other chemical pollutants. The Laboratory develops and revises air quality criteria documents on pollutants for which national ambient air quality standards exist or are proposed, provides the data for registration of new pesticides or proposed suspension of those already in use, conducts research on hazardous and toxic materials, and is preparing the health basis for non-ionizing radiation standards. Direct support to the regulatory function of the Agency is provided in the form of expert testimony and preparation of affidavits as well as expert advice to the Administrator to assure the adequacy of health care and surveillance of persons having suffered imminent and substantial endangerment of their health.

The recent air pollution episode of November 1975, in which a cloud of pollution literally descended on the valleys around Pittsburgh, Pennsylvania, presented the Health Effects Research Laboratory with a real-life situation in which our various technologies could be applied. Our recently developed computerized air monitoring system, The Community Health Air Monitoring Program (CHAMP), was able to be utilized during the Pittsburgh episode. This was done by using one of the mobile laboratory vans sent from HERL in Research Triangle Park, North Carolina, to the scene to characterize and study the pollution levels. Such study is essential to epidemiologists and other health scientists in determining the health effects in populations from pollutants. This Report describes and discusses HERL's monitoring efforts during and after the pollution alert. Much valuable information and experience was gained by our staff which will be used in future situations requiring such technical expertise.

John H. Knelson, M.D.
Director,
Health Effects Research Laboratory

ABSTRACT

In November 1975 a serious air stagnation problem developed over Western Pennsylvania, with extremely heavy air pollution in the Pittsburgh area. The United States Environmental Protection Agency's Health Effects Research Laboratory (HERL) immediately mobilized a team of air monitoring and epidemiological personnel to verify the nature of pollutants and to determine the possible health effects from this pollution. By Wednesday, November 19, pollution levels reached emergency stage, as determined by the standards of the Allegheny County Health Department, with particulate concentrations measuring 7.0 COH/1000 feet for a 24-hour average. HERL sent an EPA Community Health Air Monitoring Program (CHAMP) mobile monitoring laboratory van from Research Triangle Park, North Carolina, to provide independent verification of the Allegheny County monitoring data. School children were tested for pulmonary function near the site of monitoring facilities.

This Report describes and discusses EPA's monitoring effort during and after the pollution alert. It concludes that HERL's monitoring confirmed data collected by the local health department, that air stagnations such as this one are likely to recur, that different pollutants do not increase uniformly during an air inversion, and the Benzo-Alpha-Pyrene and suspended sulfates significantly contributed to the pollution problem. The Report includes tables and figures on relevant data gathered regarding the episode, illustrations, and a map showing monitoring sites.

ACKNOWLEDGMENTS

We gratefully acknowledge the many contributions and cooperation received in gathering data for this report. The use of data furnished by personnel of the Bureau of Air Pollution Control, Allegheny County Health Department was especially helpful. We would particularly thank Dr. Arvid Ek, Administrator of Technical Services of the Bureau, for his assistance and patience.

THE PITTSBURGH EPISODE

Introduction

On Monday, November 17, 1975, an air stagnation advisory was issued for western Pennsylvania. It was later extended to Friday, November 21. By Wednesday, pollution levels reached emergency stage[1] with particulate concentrations measured 7.0 COH/1000 feet (24-hour average) at the Allegheny County Liberty Borough site outside Pittsburgh. The Environmental Protection Agency's Health Effects Research Laboratory (HERL) in Research Triangle Park, North Carolina, then mobilized a team of air monitoring and epidemiological personnel to verify the nature of pollutants and determine the possible health effects from these high pollution levels. HERL was also needed by EPA's legal staff for possible medical testimony to curtail major industrial operations.

An EPA Community Health Air Monitoring Program (CHAMP) mobile monitoring laboratory was sent from North Carolina and arrived Thursday. However, the mobile lab was not yet fully operating when a cold front dispelled the inversion layer early Friday morning, November 21. But pollution levels during the episode were measured in detail by Allegheny County's eight automated stations. Later data gathered by the mobile van did provide independent verification of the Allegheny County data.

Schoolchildren's pulmonary function was tested in the parochial school nearest the site of the mobile monitoring laboratory and in five other area schools. South Allegheny County High School, the location of the Liberty Borough monitoring site, was not used because of inability to get necessary pulmonary testing authorization. The tests continued for one week to determine how quickly lungs recover from high air pollution. A separate report details results of these tests.[2]

Background

Pittsburgh produces one-fifth of the entire nation's steel and is also the country's largest aluminum production center. Because of the heavy concomitant production and use of coke in Pittsburgh's leviathan steel industry, Pittsburgh historically has had an air pollution problem. The city of Pittsburgh, realizing the serious gravity of this problem, has, since 1946, attempted to improve the ambient air with a number of programs. One such program was to establish an extensive air monitoring network with a staff delegated emergency powers to protect public health.

Geography

Pittsburgh, situated in the valleys formed by the juncture of the Allegheny and Monongahela Rivers, has a topography especially susceptible to air pollution episodes. The city is in sort of a "trough-box," with the banks of the rivers rising to 150 meters (approximately 500 feet) on two sides, which are further bordered by the 2000-feet-high Allegheny Mountains.

Meteorology

Stagnant air is a common phenomenon in river valleys, particularly during the colder seasons when there is not enough sunshine for vertical mixing. Air inversions such as those in Pittsburgh and Allegheny County during November 1975 keep air within these river valleys, which sets the stage for very high accumulation of pollutants.

At 12 noon on Monday, November 17, 1975, the National Weather Service Forecast Office at Pittsburgh Airport issued an Air Stagnation Advisory for western Pennsylvania, the adjoining eastern Ohio counties of Columbiana, Jefferson, Belmont and Monroe, and for the adjacent West Virginia Northern Panhandle counties of Brooke, Ohio, Hancock and Marshall.

During the severe episode recorded in Allegheny County (November 16-20, 1975), winds were limited to 10 m/s. Wind speeds averaged 1.1 m/s (2.5 mph) the morning of the 19th, the day air pollution concentrations reached emergency levels (Table 1). Vertical mixing heights reached 1455 meters above ground surface on November 16, but then failed to rise above 310 meters for the next four days, creating an inversion. (Throughout the episode, vertical mixing heights stayed below 500 meters while wind speeds held 5 m/s for 3 days.) High winds, precipitation, and a passing cold front dispelled the air inversion on the 21st. These meteorological conditions closely match those Holzworth found to occur once previously at Pittsburgh during the five years, 1960-64.[3]

Site Selection

Because of existing high pollution levels, the Liberty Borough, 18 kilometers (km) southeast of downtown Pittsburgh, was chosen for air sampling by EPA's mobile monitoring laboratory. Figure 1 shows the location of the monitoring site. The mobile laboratory was less than 100 meters from the Allegheny County monitoring site at Liberty Borough so EPA and Allegheny data could be compared for accuracy. This site consistently records one of the highest pollution index levels of all Allegheny County locations monitored. Holy Cross and St. Joseph's Schools, 2 of the 6 schools used in the epidemiological study, were within one kilometer of the Liberty Borough site. In addition, U.S. Steel's Clairton Coke Works, 3 kilometers southwest of the site, was one of the most serious pollution emission sources.

Figure 2 is a photograph of the mobile laboratory at the Liberty Borough site, showing South Allegheny High School, the monitoring site. The RSP sampler inlet, gaseous sample inlet, and hi-vol shelter are mounted from left to right on top of the van. Monitoring instruments and computer are housed inside the van.

Synopsis of Pollution Levels in Pittsburgh during 1966 and 1967

The National Air Sampling Network (NASN) collected air pollution data in the Pittsburgh area before the November episode. NASN's sampling site is located in a commercial section of downtown Pittsburgh (see Figure 1). Data from this site indicates that Pittsburgh has long had a problem with high particulate concentrations.

Figure 3 is a graph showing Total Suspended Particulates (TSP) for the years 1966 and 1967. The dashed lines across the graph at 140 and 134 micrograms per cubic meter ($\mu g/m^3$) are the geometric means for the samples taken in 1966 and 1967. This exceeds the present National Primary Air Quality Standard of 75 $\mu g/m^3$, indicated by the dotted line.

The frequency distribution graph of Suspended Sulfates (SS) for the years 1966-67 is given in Figure 4. The arithmetic mean for this period is 13.1 $\mu g/m^3$. While there are no standards pertaining to SS, the concentrations can be compared to total TSP for reference. For the years shown, arithmetic mean SS levels were 9.6 percent of geometric mean TSP concentrations. The arithmetic mean for SS during this time period and the ratio of SS to TSP will be compared to data taken during the episode.

Suspended Nitrates (SN) for the 1966-67 period are shown in Figure 5. The arithmetic mean is 2.1 $\mu g/m^3$. This mean level will be used to compare with episode levels.

Benzo-a-pyrene (BaP) concentrations for the years 1966-67, the first years of detailed BaP records in Pittsburgh, are graphed by quarters in Figure 6. The national average in the 1966-67 period of all urban areas tested is 2.7 nanograms per cubic meter (ng/m3), as indicated by the dotted line. As this graph demonstrates, downtown Pittsburgh has had a history of higher-than-average BaP concentrations. However, none of the quarters in this period had BaP concentrations. However, none of the quarters in this period had BaP levels as high as the concentrations recorded during the episode.

A frequency distribution plot of Sulfur Dioxide (SO_2), Figure 7, was made from 1967 data from the NASN downtown site. The data arithmetic mean, 66 $\mu g/m^3$, is lower than the present National Primary Standard for SO_2, 80 $\mu g/m^3$. The maximum recorded 24-hour concentration, 164 $\mu g/m^3$, is much less than the 24-hour National Primary Standard of 365 $\mu g/m^3$.

Nitrogen Dioxide (NO_2) concentrations in downtown Pittsburgh in 1967 averaged well above the National Primary Standard of 100 $\mu g/m^3$, as seen in Figure 8. The data arithmetic mean, 141 $\mu g/m^3$, represented by the dashed line, is 40 percent more than 100 $\mu g/m^3$, the dotted line. Maximum daily concentration standards have not been established.

Analysis of Recent 1974 Data at Liberty Borough Site

The three graphs (Figures 9-11) present the TSP and SO_2 data for the 1974 calendar year. The TSP graph (Figure 9) has both the National Primary Annual Standard and the corresponding observed mean indicated on the plot. The observed geometric mean, 115 micrograms per cubic meter, is well above the standard of 75 $\mu g/m^3$. The maximum observed value, 473 $\mu g/m^3$, greatly exceeds the maximum primary 24-hour standard of 260 $\mu g/m^3$.

From the daily TSP plot in the months of November 1973, 1974 and 1975 (Figure 10), the past three years can be easily compared. Although the 1975 data (squares) obviously exceeds the other two years, in both November 1973 and November 1974, the maximum national 24-hour standard was exceeded. If TSP had been sampled daily instead of every 2-4 days, more data points both above and below the standards would appear on the graphs.

The SO_2 concentrations in 1974 were also high. As indicated by the graph (Figure 11), 50 percent of the values exceeded the National Primary Standard of 80 $\mu g/m^3$, with a resultant average of 142 $\mu g/m^3$. This high average concentration approaches twice the standard.

Neither SN, NO_2, nor carbon monoxide are routinely sampled at the Liberty Borough site. Data pertaining to these pollutants were obtained during the episode and are presented in the next section.

Analysis of TSP/COH, SS, SN Data during Episode

EPA's mobile van did not become fully operational until shortly after the weather frontal passage caused wind and precipitation to cleanse the air over Pittsburgh. EPA data, therefore, are available only for the week following the episode. These data do provide independent verification of Allegheny County data although EPA data are limited to the lower concentrations present after the episode. An EPA National Air Surveillance Network (NASN) station located within Pittsburgh samples every twelfth day. Unfortunately the sampling period bracketed the episode.

Allegheny County Health Department maintains seven continuous telemetering stations in and around Pittsburgh. Data from one of these sites, the Liberty Borough site, is graphically represented by Figures 12-15 and 17-19.

TSP concentrations at the Liberty Borough site from November 10-November 29 are shown in Figure 12. The highest concentration recorded during the episode, 921 $\mu g/m^3$, represents a

15-hour average during Wednesday, November 19, 1975. This peak value, 921 $\mu g/m^3$, does not show in Figure 12 because concentrations are graphed as 24-hour values. Sampling time was reduced from the usual 24-hour collection period because air flow through the high volume sampling instrument was being significantly reduced by the build-up of particles on the filter. Thus, the 770 $\mu g/m^3$ value shown on the graph is a time-weighted average of the two samples taken November 19, 1975. This value greatly exceeds the maximum national primary daily standard of 260 $\mu g/m^3$, as shown by the dotted line on the graph. Graphed TSP concentrations after November 20 from both EPA and Allegheny County indicate more modest pollution levels. Correspondence between the two data sets may have been improved if sampling frequency could have been the same: EPA's daily sampling indicated slightly lower concentrations.

Coefficient of Haze (COH), for which there is no national standard, was used as an indicator to declare an emergency episode. COH is compared with total suspended particulates through the formula: 1 COH = 100 (TSP) $\mu g/m^3$, at the Liberty Borough site only.[2] Because of the ratio of fine to coarse suspended particulates and particulate composition vary geographically, the above ratio will not necessarily apply outside the Liberty Borough area. A graph of the COH values at Liberty Borough (Figure 13) may be compared to that of TSP (Figure 12) for the episode period. The extreme peak on the TSP graph appears as a more gradual rise with COH. Using the above conversion formula, an expected TSP value for Wednesday, November 19, would be average daily COH (7.37)

times $\frac{100\ \mu g/m^3}{COH}$ equals 737 $\mu g/m^3$ TSP. The measured value of 921 $\mu g/m^3$ is within the 30 percent accuracy attributed to this conversion by Allegheny County.

Very high suspended sulfate (SS) concentrations were present in the hi-vol samples collected at the Liberty Borough site as shown in Figure 14. The dotted line at the very bottom of the graph is the mean sulfate concentration for the 1966-67 period as seen in Figure 4. The uncommonly high concentration of 191 $\mu g/m^3$ recorded on November 19 is the time-weighted average from two hi-vol samples taken that day. SS averaged 10 percent of TSP values during 1966-67, 19 percent during the week of the episode, and 25 percent of TSP values on November 19, 1975, the day SS and TSP values peaked. Unfortunately, comparison between SS determinations on EPA and Allegheny collected TSP samples is only possible on November 21. As the graph shows, the two hi-vol sample values nearly coincide. The same laboratory conducted both sample analyses.

Suspended Nitrate (SN) concentrations at Liberty, depicted in Figure 15, did not appear to be unusually affected by the inversion. The peak concentration recorded, 10 $\mu g/m^3$, occurred on November 18, a day before concentrations peaked for SS and TSP. Six days later, November 24, another peak was recorded, this one reaching 7.6 $\mu g/m^3$. The SN levels during the episode are little higher than SN levels after the episode. Most of the data shown in Figure 15 is far above the mean 1966-67 concentration of 2.1 $\mu g/m^3$. This may be due to the differences in the pollution levels

between the commercial downtown site in 1965-67 and the industrial Liberty Borough site with which it is being compared in the graph. As in SS, comparisons between Allegheny County and EPA SN data is limited to one day, with that day coinciding on the graph. One laboratory also analyzed both samples.

Analysis of Benzo-a-Pyrene (BaP) Data during Episode

Hi-vol samples collected by Allegheny County were sent to EPA to analyze SS, SN and BaP. Figure 16 presents the BaP results. A number of samples are usually composited to increase chemical analysis accuracy due to the small quantity of BaP in hi-vol samples. Batch #1 is a combination of 20 hi-vol samples taken from several different sites in the Pittsburgh area during the week before the episode. Batch #2 is of 25 samples taken during the episode week. Batch #3 is composed of 11 samples taken the week after the episode. The national average computed for urban areas is the dotted line at the bottom of the graph at 2 nanograms/cubic meter. An exceptionally high value of 184 nanograms per cubic meter was recorded for Batch #2. This high value is flanked by 18 nanogram/m^3 from Batch #1 taken before and 21 nanograms/m^3 from Batch #3 taken after the episode. While there is no national standard established concerning BaP concentrations in ambient air, BaP is a suspected carcinogen. More samples need to be collected to substantiate these very high recorded concentrations.

Comparing the 1975 BaP concentrations (Figure 16) with those of earlier years (Figure 6) shows little correlation between past and present pollution levels. Some discrepancies would be expected because of site differences since the 1966-67 years' data

were taken from one downtown site, while the 1975 data is a conglomerate of 12 sites in the Pittsburgh area. The industrial sites, such as Liberty Borough, would be expected to yield higher BaP concentrations than the more commercial downtown sites. As BaP emissions are strongly associated with coking operations, high concentrations during an air inversion would be expected in Pittsburgh. However, since "emergency" episodes are a rare occurrence, duplication of the high BaP results would be difficult. A previous EPA publication reported annual average BaP concentrations in Pittsburgh of 6, 14 and 6 nonograms/m^3 for the years 1968-70.[5] A hi-vol sample collected at Liberty Borough on July 11, 1976 gave the following results: TSP, 113.7 $\mu g/m^3$; BaP, 98.66 ng/m^3.[2]

Analysis of SO_2-NO_2-CO Data during Episode

For SO_2, high readings are apparent at the Liberty Borough site two days before the air stagnation advisory was issued on Monday, November 17, 1975, as seen in Figure 17. The maximum 24-hour average concentrations, 325 $\mu g/m^3$ occurred on November 16, but this value does not exceed the National Primary Daily Standard for SO_2, 365 $\mu g/m^3$ (dotted line on graph). Highest one-hour average (for which there is no standard) was recorded two days later as 812 $\mu g/m^3$.

Unexpectedly high SO_2 hourly averages were recorded by EPA on the weekend following the episode as presented in Figure 18. Concentrations briefly exceeded the range setting of the instrument, 524 $\mu g/m^3$ (0.2 ppm) in two separate hours on the morning of the 23rd. Allegheny County data do not show these peaks, but

otherwise the data follow the same curve pattern as EPA data. A consistent bias between the two data sets can be seen on the graph (Figure 18). This is probably attributed to the difference between the sampling sites or the instruments themselves. Allegheny's sampling intake was two stories above ground level, while EPA's was one story. Inlet sampling lengths were different for the two sites. Separation between the sites was approximately 100 meters, with South Allegheny County High School in between. Because sudden rises and falls of SO_2 concentrations are characteristic of this geographical area, the separation is significant. EPA used a flame photometric SO_2 monitor, while Allegheny County used a coulometric monitor for SO_2 sampling. No differences between the two instruments were found when a quick calibration check was conducted. However, the calibration check did not include response time or sampling inlet differences.

NO_2 hourly levels exceeded 100 $\mu g/m^3$, the national standard arithmetic mean, on Sunday, November 23, 1975, for about 10 hours (Figure 19). The daily average did not exceed 100 $\mu g/m^4$, indicating that annual averages would probably fall below national standards. This differs from the results in 1967 (Figure 8) when the average exceeded 100 $\mu g/m^3$. This difference may be caused by the different NO_2 pollutant levels present in the downtown site (1967 data) versus the industrial Liberty site (1975 data). The limited quantity of data available for NO_2 at the Liberty Borough site limits the data comparisons. The only NO_2 monitor in Pittsburgh during the episode was a bubbler operated under NASN.

Sampling is on a regular schedule which, unfortunately, missed the episode.

Figure 20 is a plot of the CO concentration during the episode month at a downtown site within the city limits. The line of arrows across the top of the graph is the National Standard for maximum one-hour average concentrations, 40,000 $\mu g/m^3$. At no time did the highest hourly concentrations exceed this value. However, the daily 24-hour averages did exceed 10,000 $\mu g/m^3$ (the National Primary Standard for maximum 8-hour concentrations) for a three-day period during the episode. This can be seen by comparing the solid line, representing average daily concentrations, with the dotted line near the bottom of the graph. A standard for CO 24-hour averages or 8-hour data averages, if available, should show more striking differences.

Conclusions

1. HERL's monitoring program in Pittsburgh confirmed data collected by Allegheny County, permitting greater confidence in local data used to determine health effects.
2. Air pollution concentrations in the Pittsburgh area exceeded National Primary annual Standards for both SO_2 and TSP at the Liberty Borough site before the November episode.
3. Air pollution concentrations showed marked increases before and during the stagnation advisory.
4. Air stagnations of similar magnitude to November 1975 are likely to reoccur in the future.
5. Different pollutants do not increase uniformly during an air inversion.

6. Benzo-Alpha-Pyrene and suspended sulfates significantly contributed to the Pittsburgh pollution problem.

Recommendations

Benzo-Alpha-Pyrene should be routinely analyzed from hi-vol filters in the Pittsburgh area to verify and help control their contribution to local air pollution.

References

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PITTSBURGH WEATHER INFORMATION

Date 1975	0700 Mixing Height* (meters)	0700 EST Wind** (dir/kts/m/s)	1900 EST Mixing Depth (meters)	1900 EST Wind (dir/kts/m/s)	Temperature High/Low
11/15					44/25
11/16	670	270-10-5 m/s	1455	290-10-5 m/s	55/34
11/17	130	300-13-7 m/s	874	250-15-8 m/s	62/35
11/18	186	310-10-5 m/s	125	251-10-5 m/s	63/36
11/19	115	190-5-2.6 m/s	122	250-10-5 m/s	63/35
11/20	144	210-10-5 m/s	236	170-20-10 m/s	63/35
11/21	no inversion 0.14" precipitation	250-20-10 m/s	no inversion	250-30-15 m/s	56/35
11/22	0.01" precipitation	270-20-10 m/s	no inversion	30-10-5 m/s	37/27

*Height above ground level at airport. Airport is 360 meters above sea level.
**Wind speed measured at height of 10 meters above ground level.

Table 1

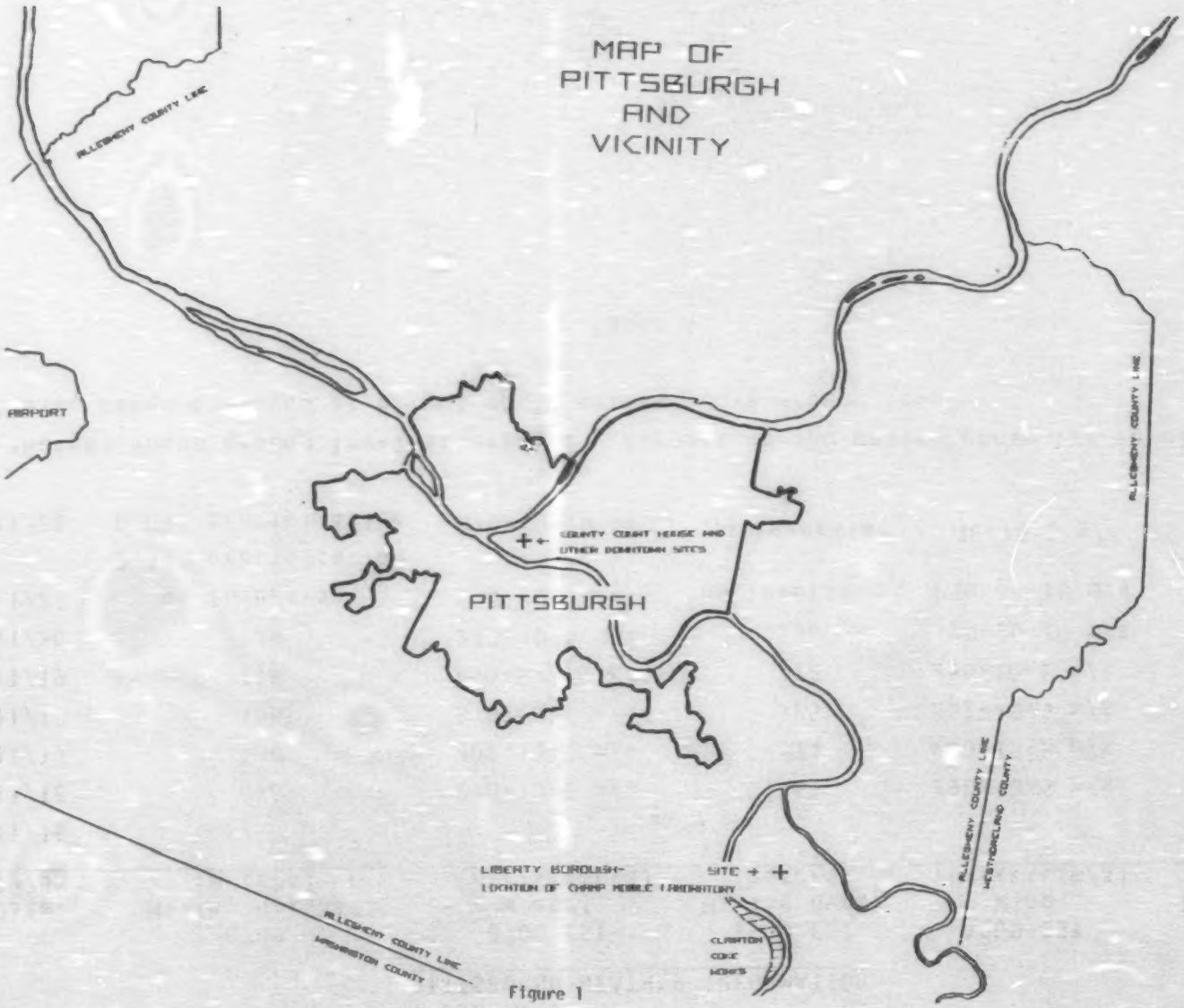
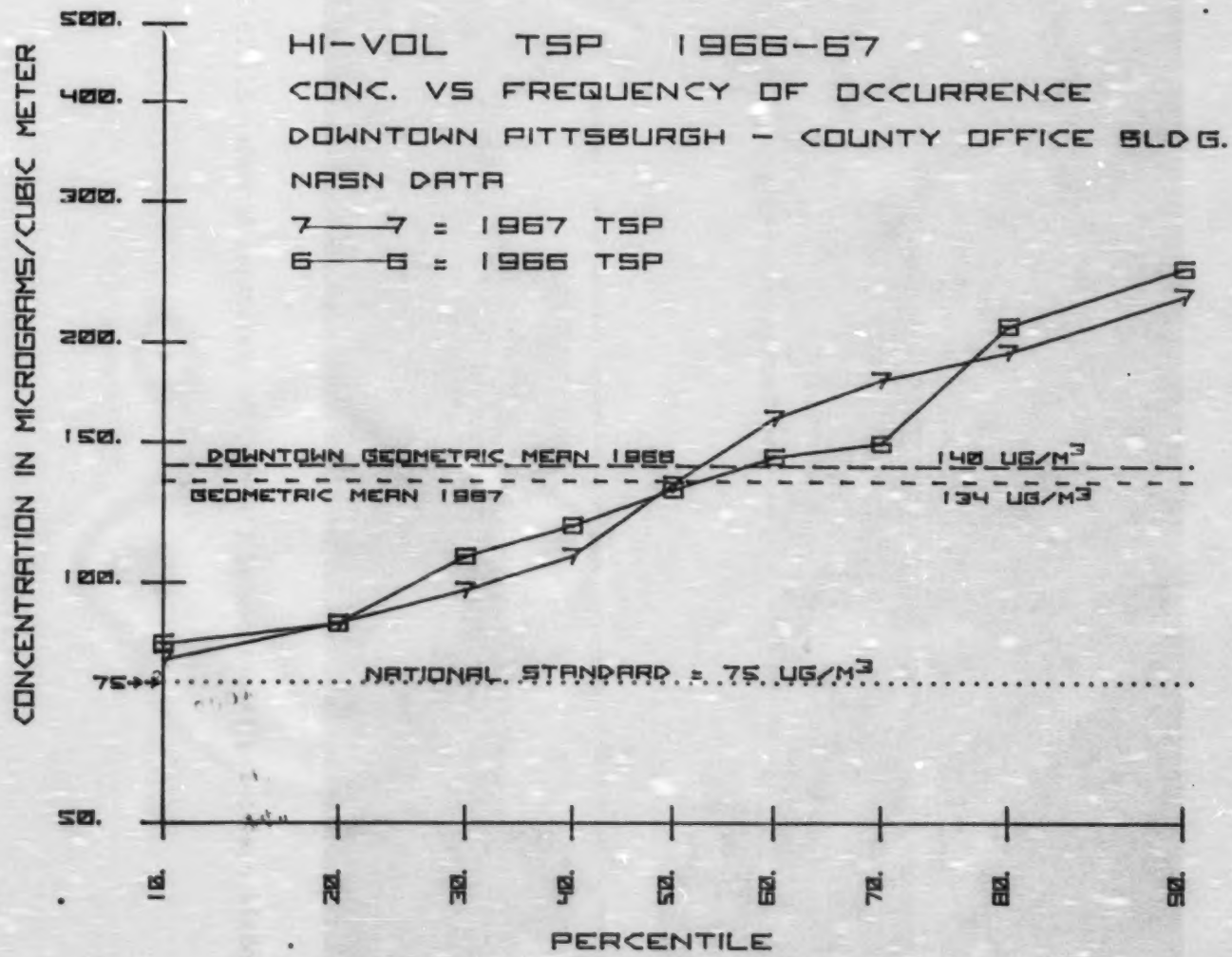

MAP OF
PITTSBURGH
AND
VICINITY
ALLEGHENY COUNTY LINE
AIRPORT
COUNTY COURT HOUSE AND
OTHER DOWNTOWN SITES
PITTSBURGH
ALLEGHENY COUNTY LINE
ALLEGHENY COUNTY LINE
WESTMORELAND COUNTY
LIBERTY BOROUGH-
LOCATION OF CHAMP MOBILE LABORATORY
SITE
CLAIRTON
COKE
WORKS
ALLEGHENY COUNTY LINE
WASHINGTON COUNTY

Figure 1

EPA mobile monitoring laboratory at Liberty, Pennsylvania; November 22, 1975

Figure 2


HI-VOL TSP 1966-67
CONC. VS FREQUENCY OF OCCURRENCE
DOWNTOWN PITTSBURGH - COUNTY OFFICE BLDG.
NASN DATA
7——7 = 1967 TSP
6——6 = 1966 TSP
DOWNTOWN GEOMETRIC MEAN 1966
140 UG/M3
GEOMETRIC MEAN 1967
134 UG/M3
NATIONAL STANDARD = 75 UG/M3
CONCENTRATION IN MICROGRAMS/CUBIC METER
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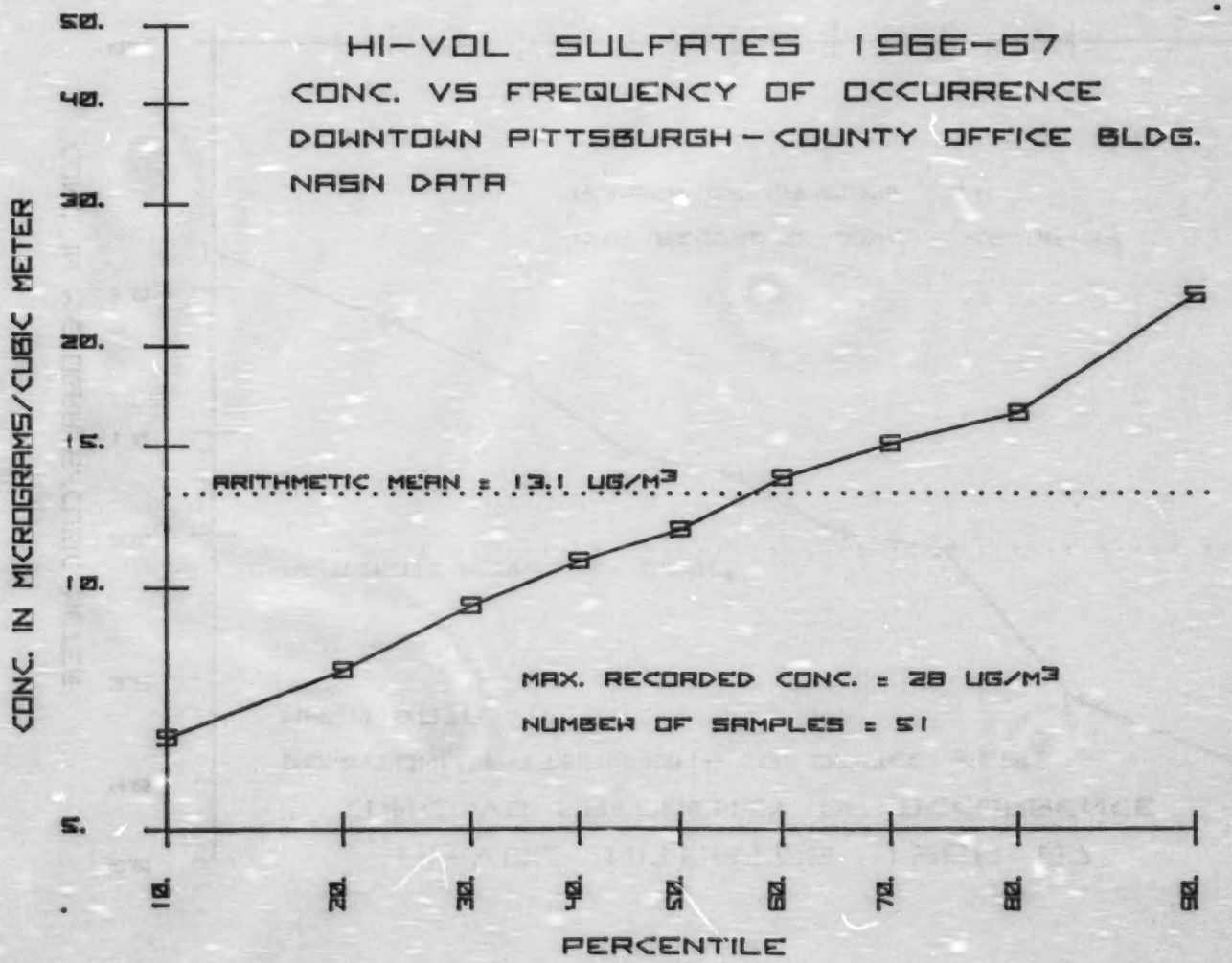
PERCENTILE

Figure 3


HI-VOL SULFATES 1966-67
CONC. VS FREQUENCY OF OCCURRENCE
DOWNTOWN PITTSBURGH - COUNTY OFFICE BLDG.
NASN DATA
CONC. IN MICROGRAMS/CUBIC METER
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40.
30.
20.
15.
10.
5.
ARITHMETIC MEAN = 13.1 UG/M3
MAX. RECORDED CONC. = 28 UG/M3
NUMBER OF SAMPLES = 51
10.
20.
30.
40.
50.
60.
70.
80.
90.
PERCENTILE

Figure 4

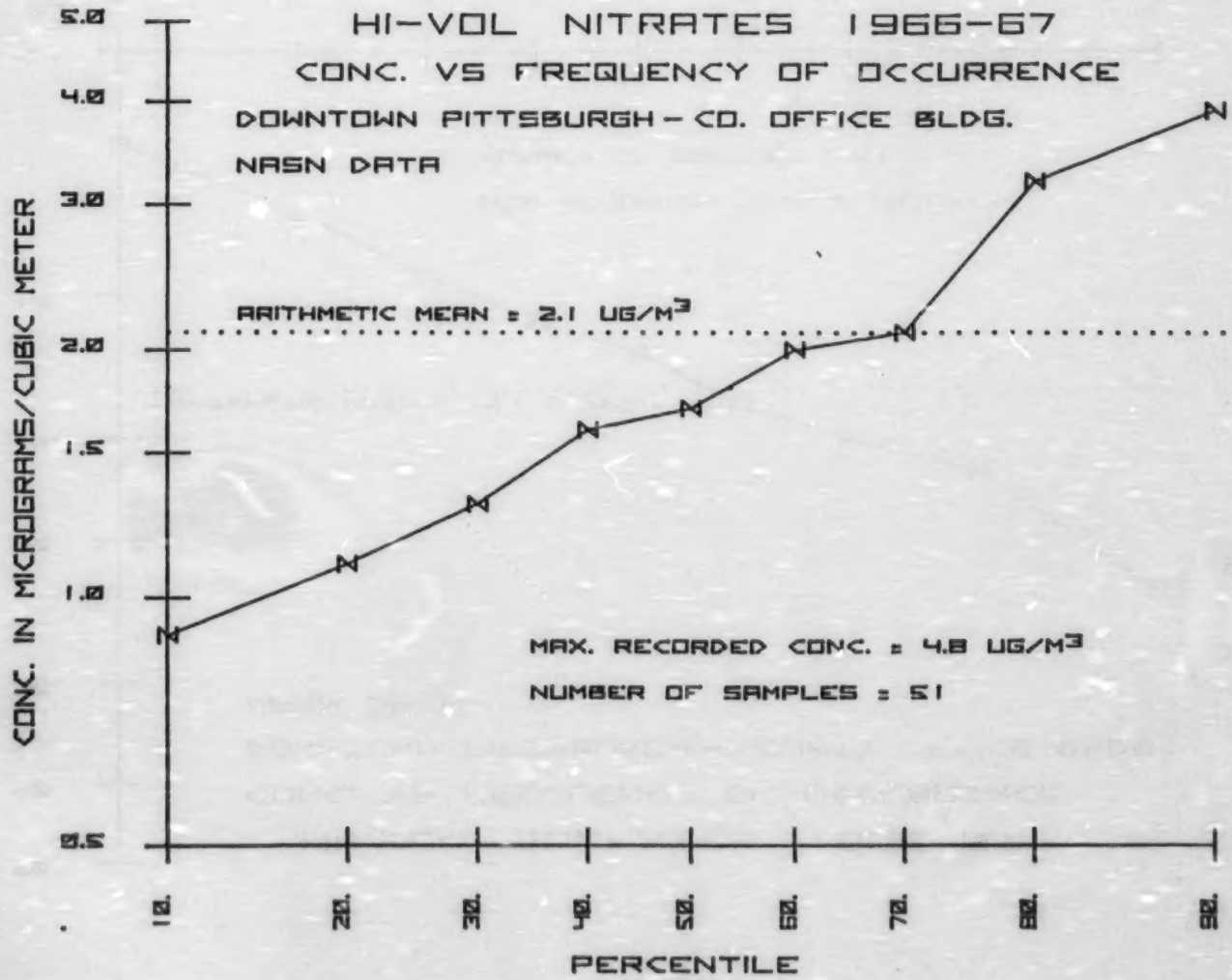

HI-VOL NITRATES 1966-67
CONC. VS FREQUENCY OF OCCURRENCE
DOWNTOWN PITTSBURGH - CO. OFFICE BLDG.
NASN DATA
ARITHMETIC MEAN = 2.1 UG/M3
MAX. RECORDED CONC. = 4.8 UG/M3
NUMBER OF SAMPLES = 51
CONC. IN MICROGRAMS/CUBIC METER
5.0
4.0
3.0
2.0
1.5
1.0
0.5
10.
20.
30.
40.
50.
60.
70.
80.
90.
PERCENTILE

Figure 5

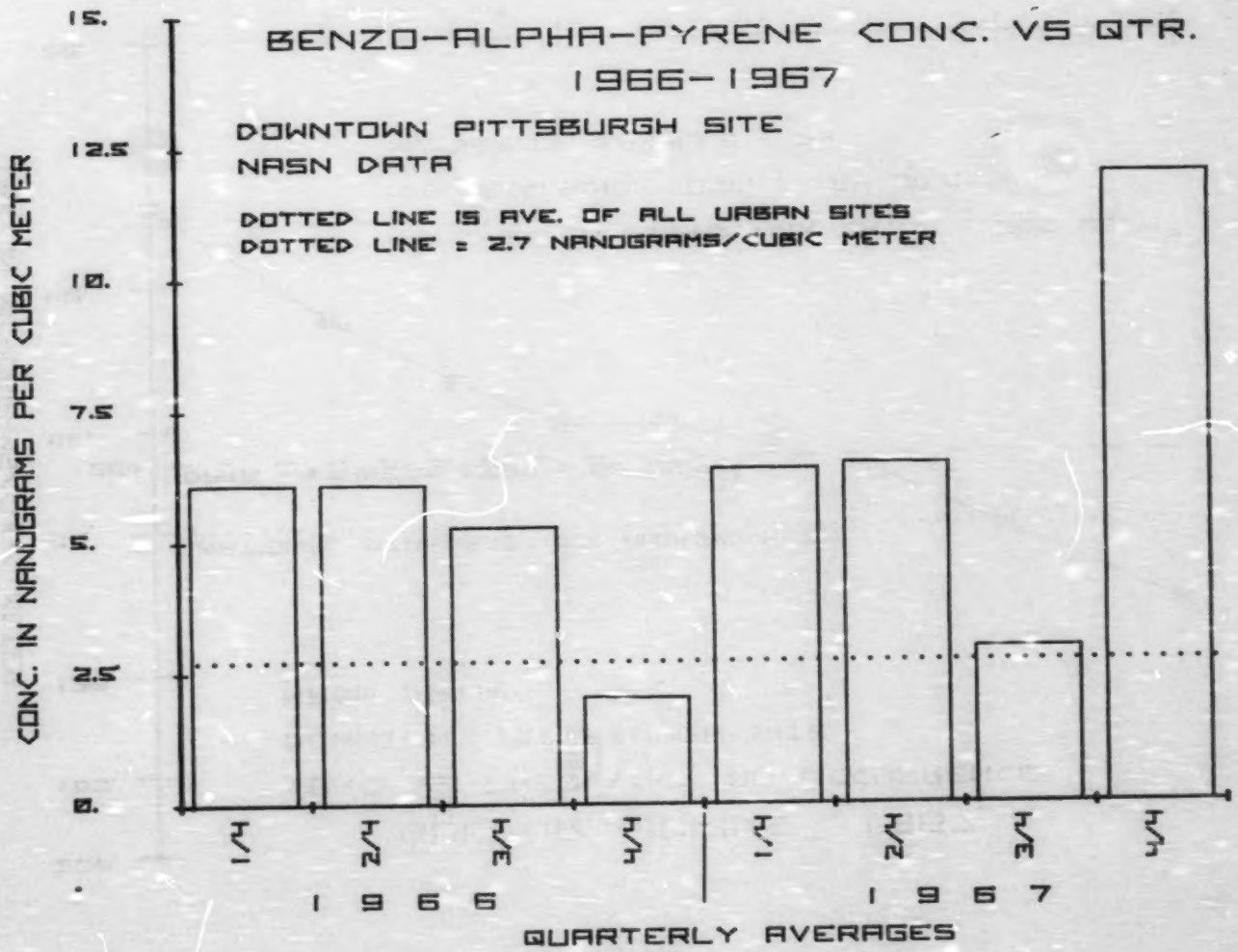

BENZO-ALPHA-PYRENE CONC. VS QTR.
1966-1967
DOWNTOWN PITTSBURGH SITE
NASN DATA
DOTTED LINE IS AVE. OF ALL URBAN SITES
DOTTED LINE = 2.7 NANOGRAMS/CUBIC METER
CONC. IN NANOGRAMS PER CUBIC METER
15.
12.5
10.
7.5
5.
2.5
0.
1/4
2/4
3/4
4/4
1/4
2/4
3/4
4/4
1 9 6 6
1 9 6 7
QUARTERLY AVERAGES

Figure 6

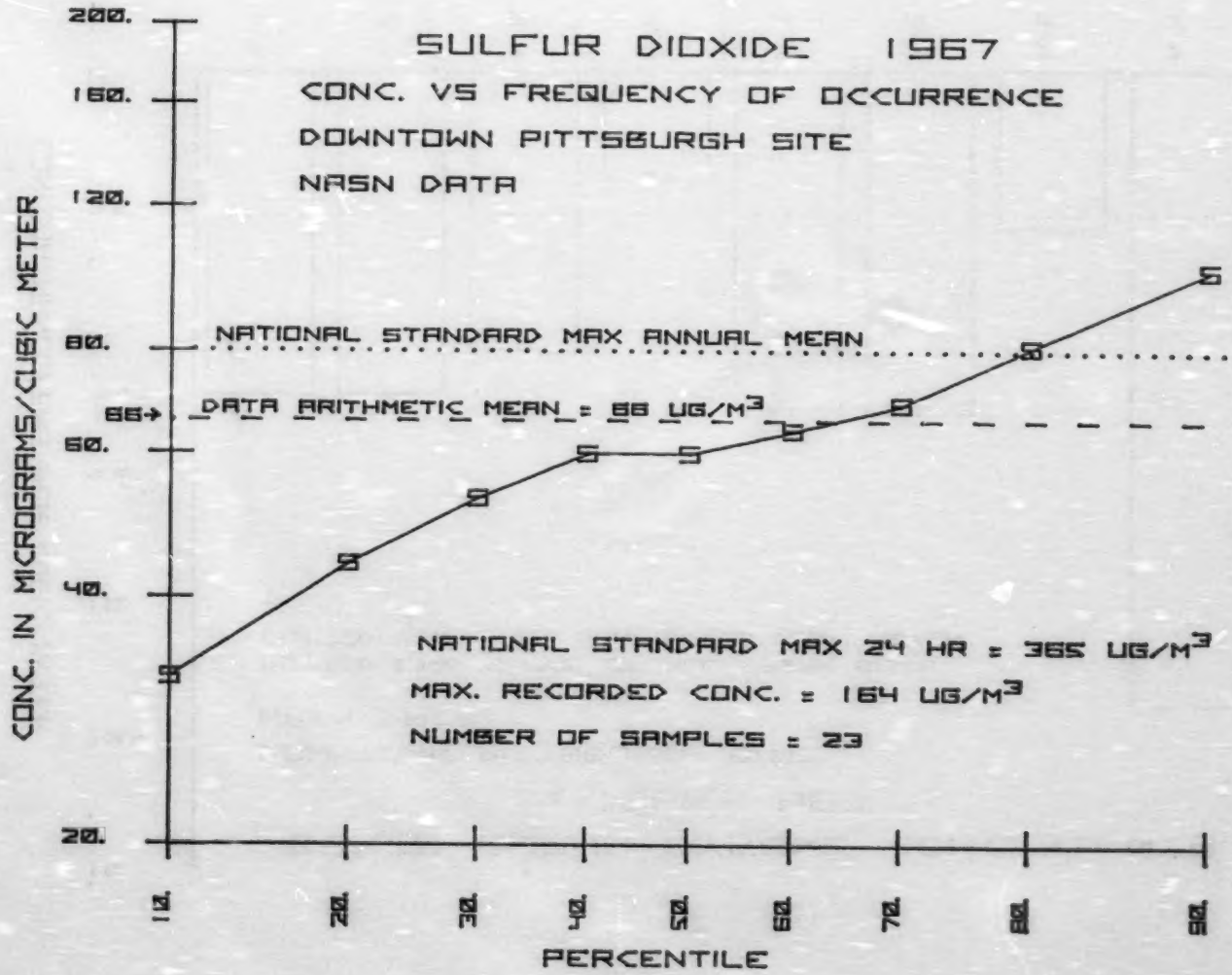

SULFUR DIOXIDE 1967
CONC. VS FREQUENCY OF OCCURRENCE
DOWNTOWN PITTSBURGH SITE
NASN DATA
NATIONAL STANDARD MAX ANNUAL MEAN
DATA ARITHMETIC MEAN = 66 UG/M3
NATIONAL STANDARD MAX 24 HR = 365 UG/M3
MAX. RECORDED CONC. = 164 UG/M3
NUMBER OF SAMPLES = 23
CONC. IN MICROGRAMS/CUBIC METER
200.
160.
120.
80.
66→
60.
40.
20.
10.
20.
30.
40.
50.
60.
70.
80.
90.
PERCENTILE

Figure 7

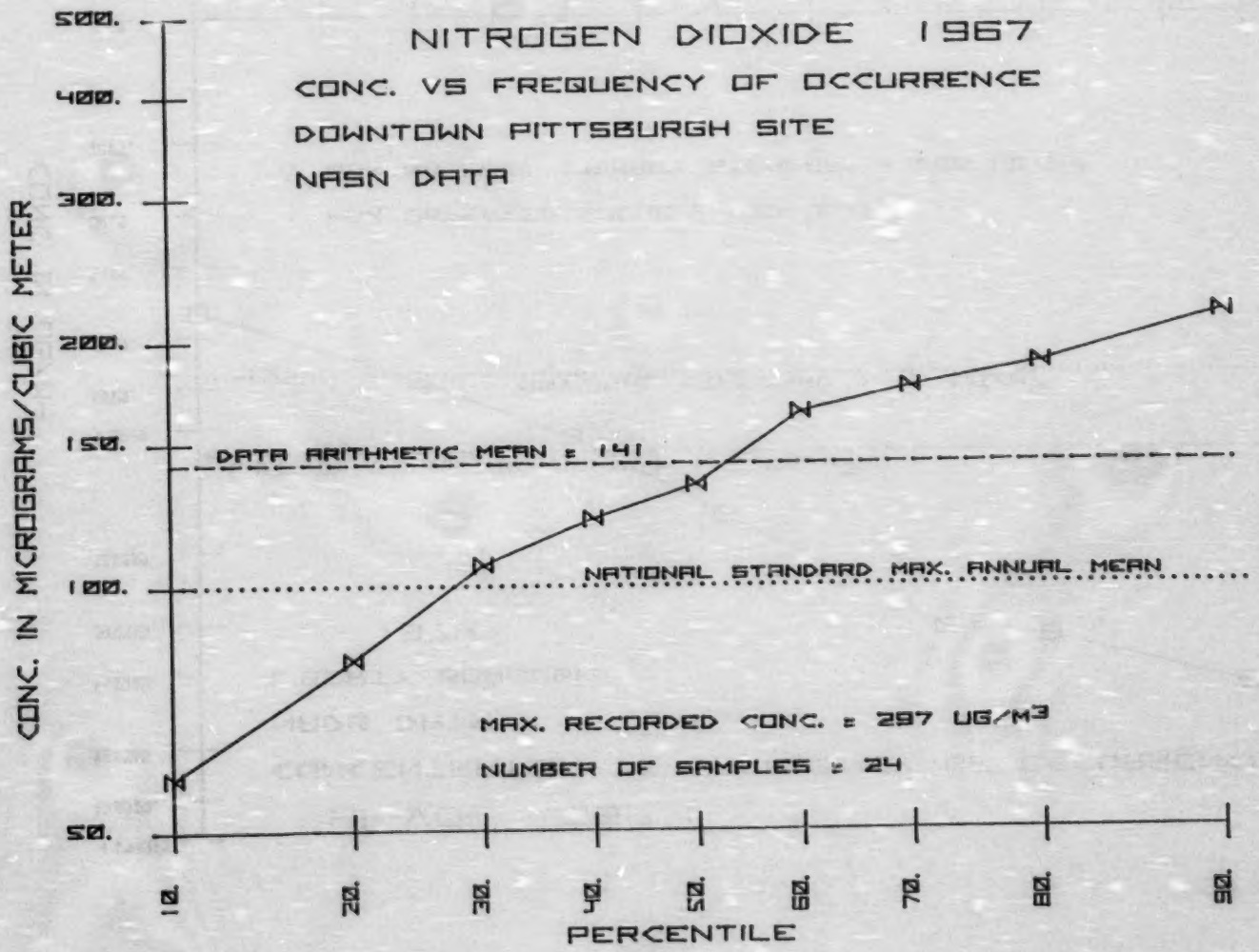

NITROGEN DIOXIDE 1967
CONC. VS FREQUENCY OF OCCURRENCE
DOWNTOWN PITTSBURGH SITE
NASN DATA
CONC. IN MICROGRAMS/CUBIC METER
500.
400.
300.
200.
150.
100.
50.
DATA ARITHMETIC MEAN = 141
NATIONAL STANDARD MAX. ANNUAL MEAN
MAX. RECORDED CONC. = 297 UG/M3
NUMBER OF SAMPLES = 24
10.
20.
30.
40.
50.
60.
70.
80.
90.
PERCENTILE

Figure 8

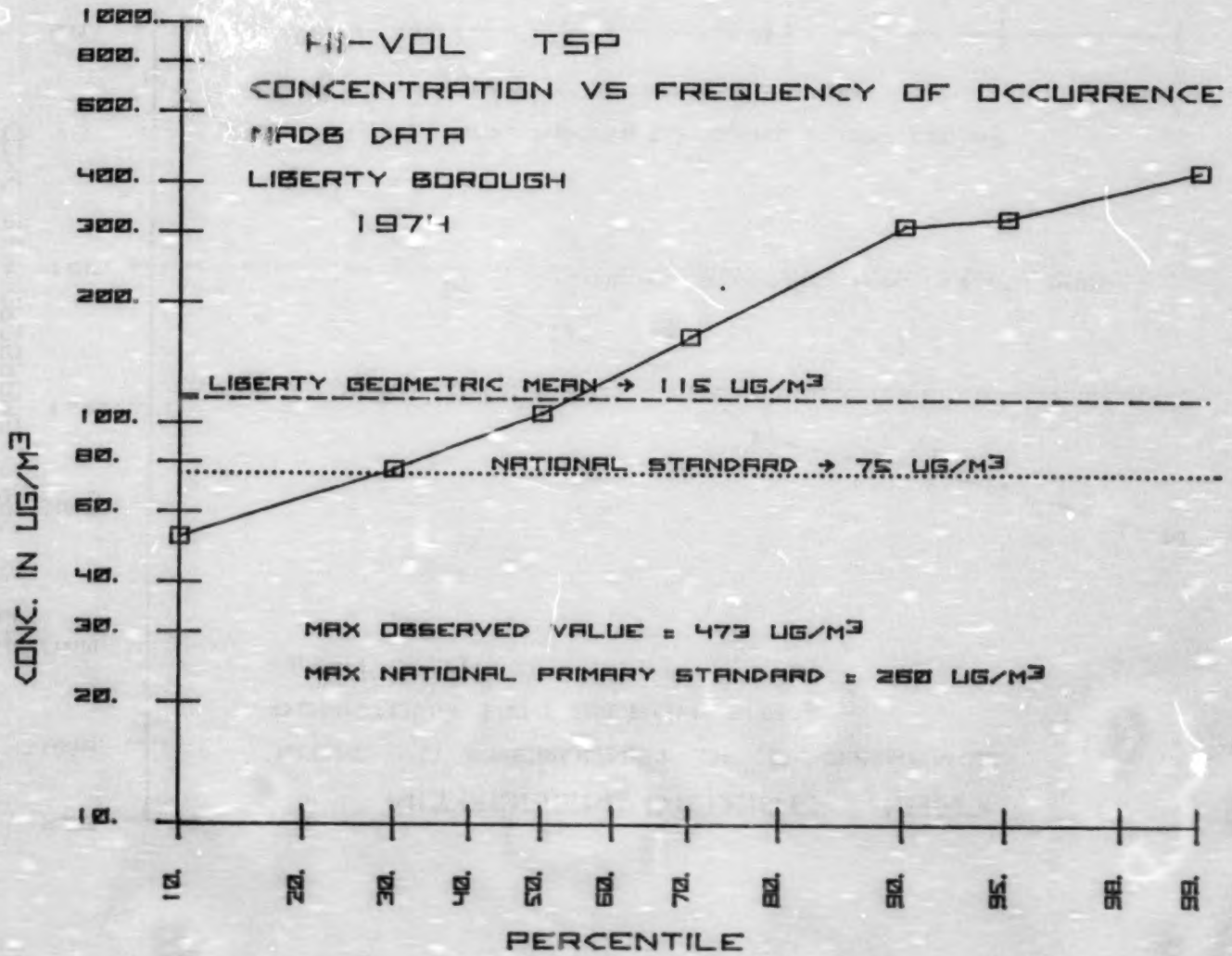

HI-VOL TSP
CONCENTRATION VS FREQUENCY OF OCCURRENCE
NADB DATA
LIBERTY BOROUGH
1974
LIBERTY GEOMETRIC MEAN → 115 UG/M3
NATIONAL STANDARD → 75 UG/M3
MAX OBSERVED VALUE = 473 UG/M3
MAX NATIONAL PRIMARY STANDARD = 260 UG/M3
CONC. IN UG/M3
1000.
800.
600.
400.
300.
200.
100.
80.
60.
40.
30.
20.
10.
10.
20.
30.
40.
50.
60.
70.
80.
90.
95.
98.
99.
PERCENTILE

Figure 9

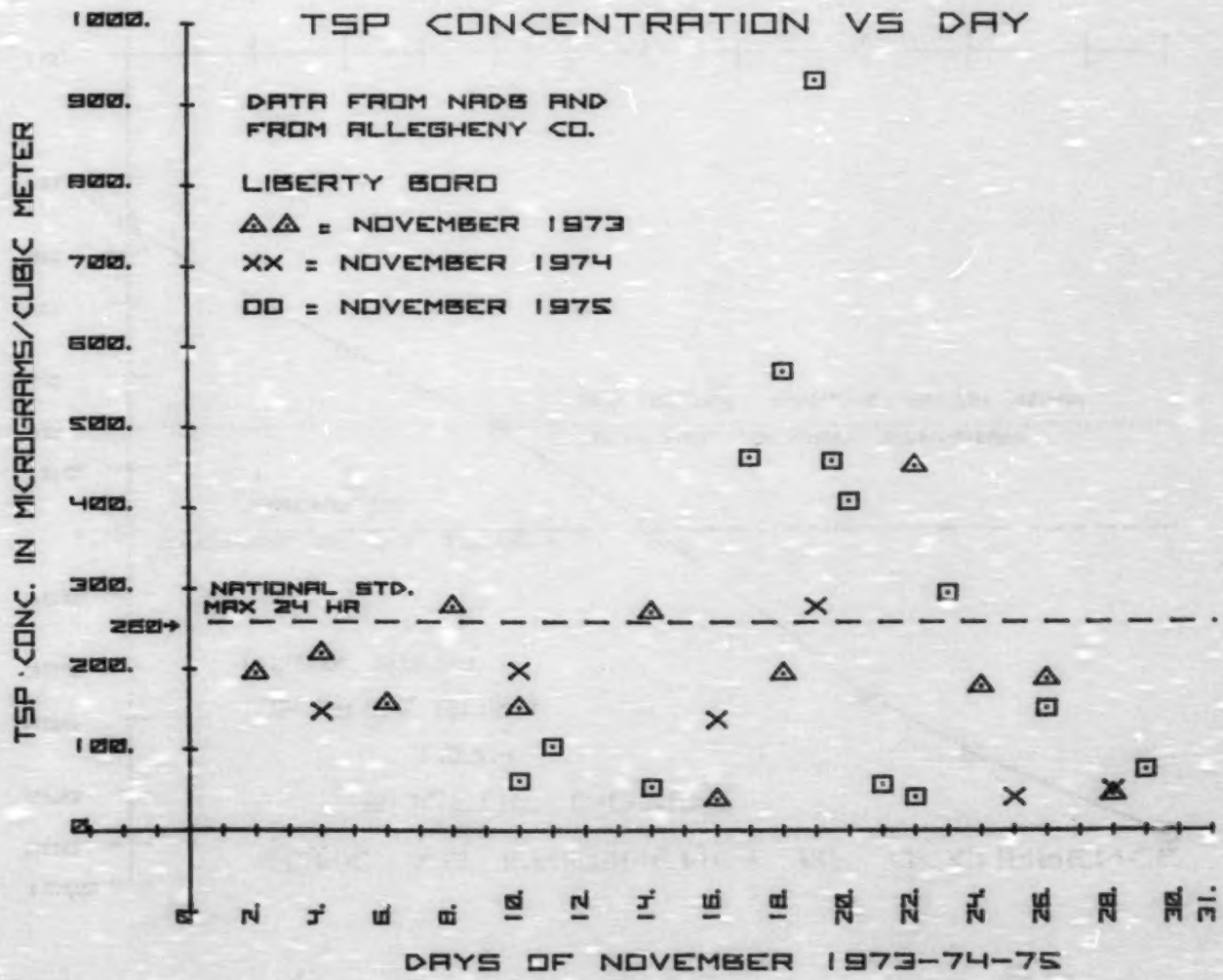

TSP CONCENTRATION VS DAY
DATA FROM NADB AND
FROM ALLEGHENY CO.
LIBERTY BORO
△△ = NOVEMBER 1973
XX = NOVEMBER 1974
□□ = NOVEMBER 1975
NATIONAL STD.
MAX 24 HR
260→
TSP CONC. IN MICROGRAMS/CUBIC METER
1000.
900.
800.
700.
600.
500.
400.
300.
200.
100.
0.
0.
2.
4.
6.
8.
10.
12.
14.
16.
18.
20.
22.
24.
26.
28.
30.
31.
DAYS OF NOVEMBER 1973-74-75

Figure 10

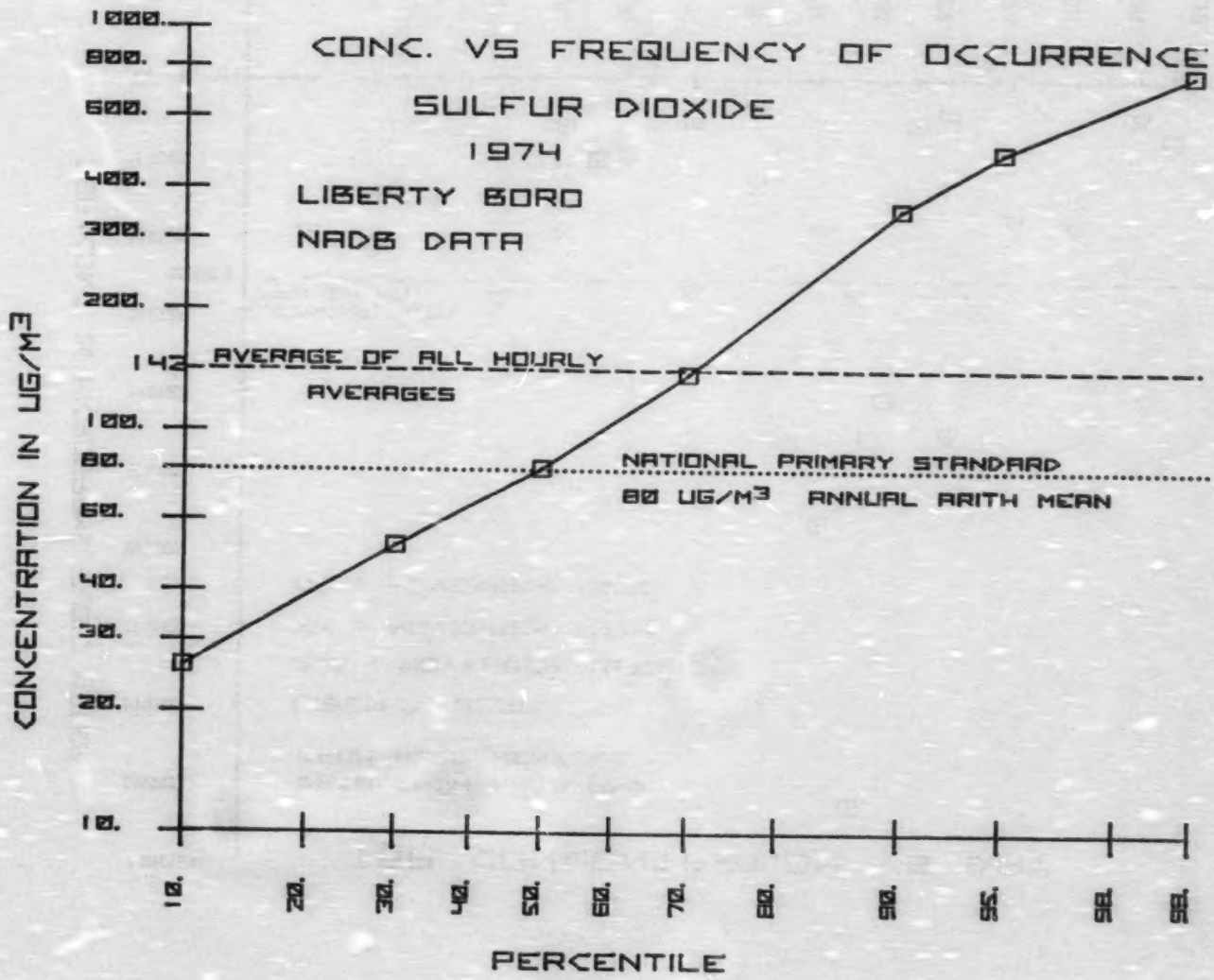

CONC. VS FREQUENCY OF OCCURRENCE
SULFUR DIOXIDE
1974
LIBERTY BORO
NADB DATA
AVERAGE OF ALL HOURLY
AVERAGES
142
NATIONAL PRIMARY STANDARD
80 UG/M3 ANNUAL ARITH MEAN
CONCENTRATION IN UG/M3
1000.
800.
600.
400.
300.
200.
100.
80.
60.
40.
30.
20.
10.
10.
20.
30.
40.
50.
60.
70.
80.
90.
95.
98.
99.
PERCENTILE

Figure 11

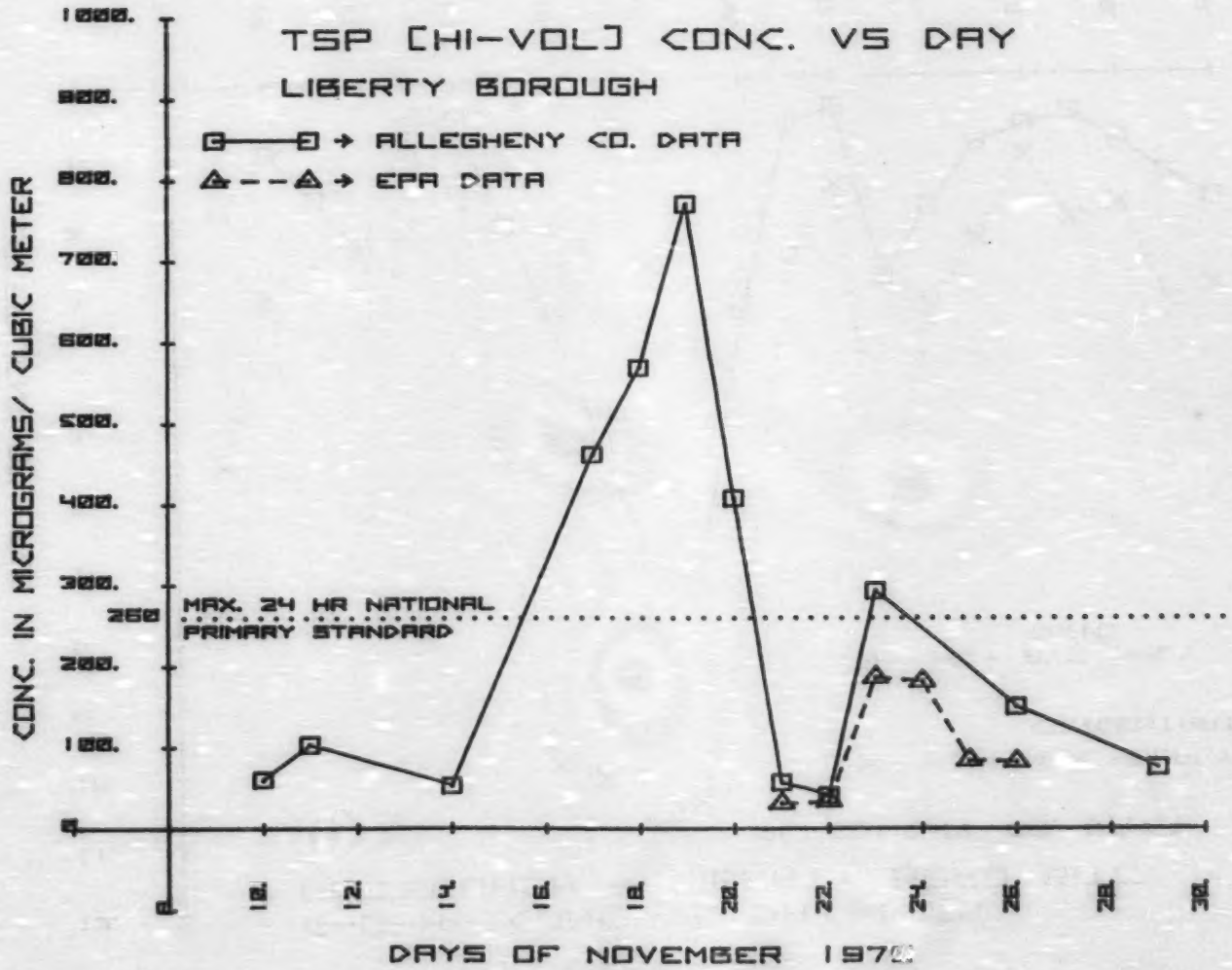
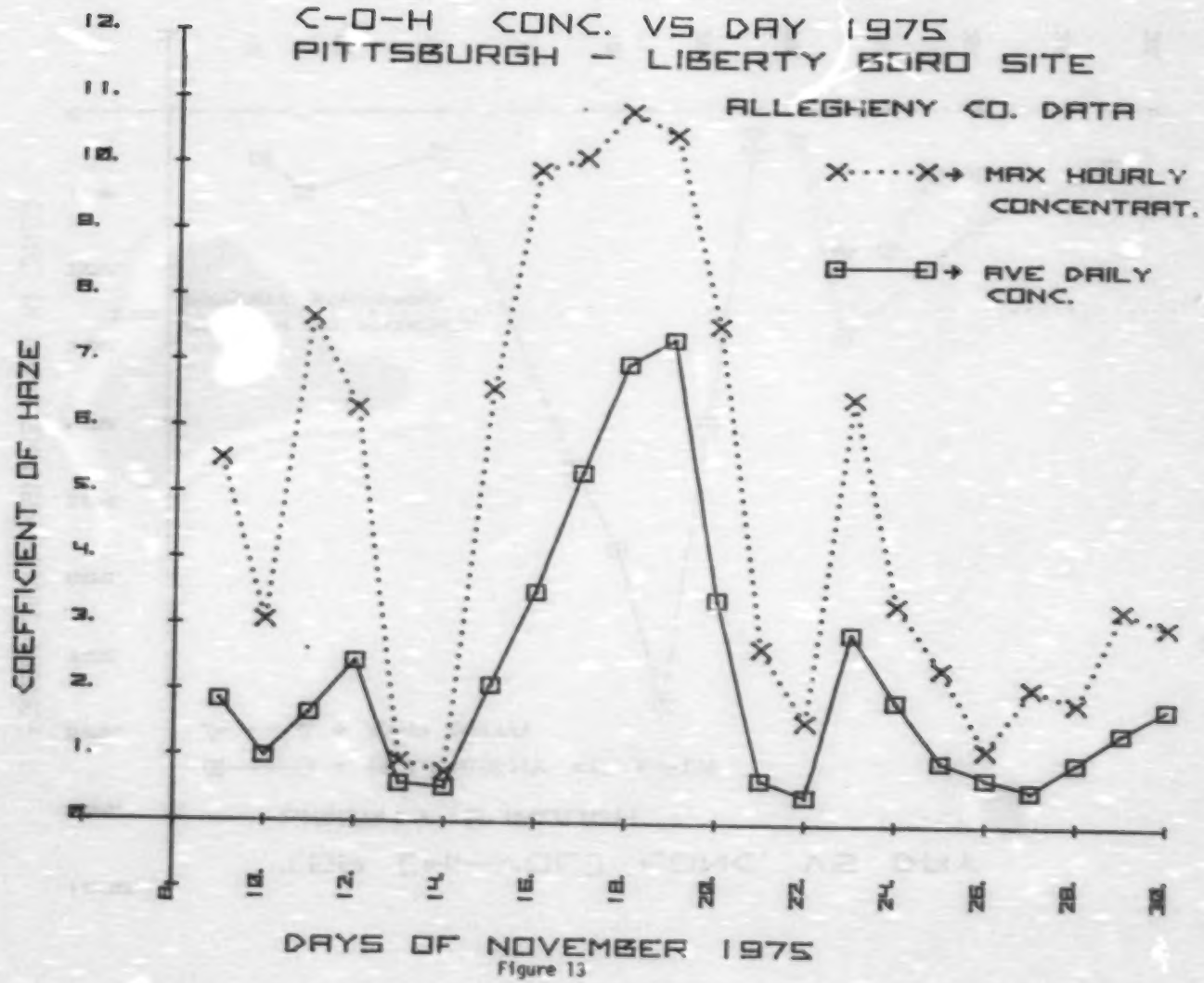

TSP [HI-VOL] CONC. VS DAY
LIBERTY BOROUGH
ALLEGHENY CO. DATA
EPA DATA
CONC. IN MICROGRAMS/ CUBIC METER
1000.
900.
800.
700.
600.
500.
400.
300.
250
200.
100.
0
MAX. 24 HR NATIONAL
PRIMARY STANDARD
10
12
14
16
18
20
22
24
26
28
30
DAYS OF NOVEMBER 1970

Figure 12


C-O-H CONC. VS DAY 1975
PITTSBURGH - LIBERTY BORO SITE
ALLEGHENY CO. DATA
X·····X→ MAX HOURLY CONCENTRAT.
⊡——⊡→ AVE DAILY CONC.
COEFFICIENT OF HAZE
0. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.
0. 10. 12. 14. 16. 18. 20. 22. 24. 26. 28. 30.
DAYS OF NOVEMBER 1975
Figure 13

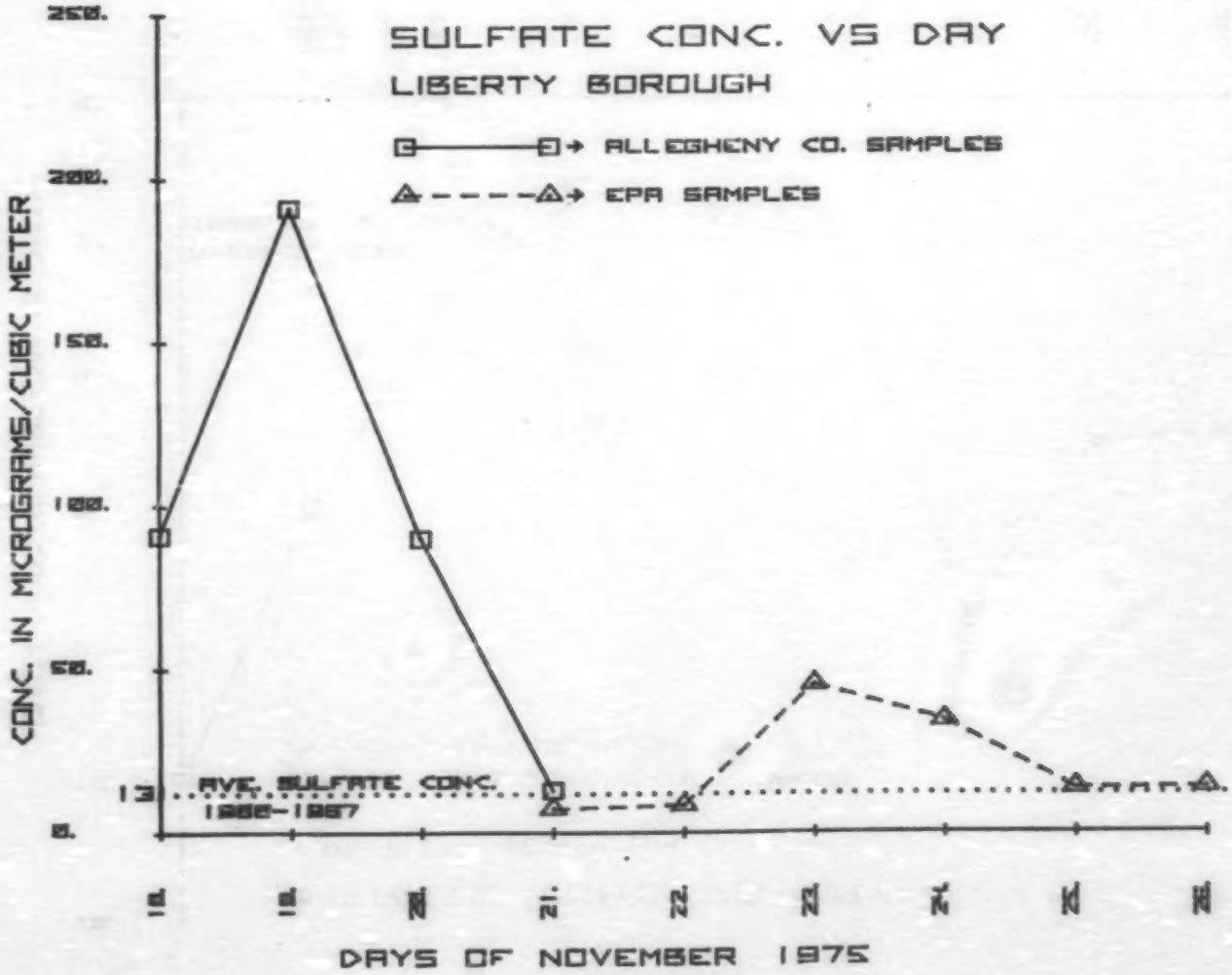

SULFATE CONC. VS DAY
LIBERTY BOROUGH
ALLEGHENY CO. SAMPLES
EPA SAMPLES
CONC. IN MICROGRAMS/CUBIC METER
250.
200.
150.
100.
50.
13
0.
AVE. SULFATE CONC.
1966-1967
DAYS OF NOVEMBER 1975

Figure 14

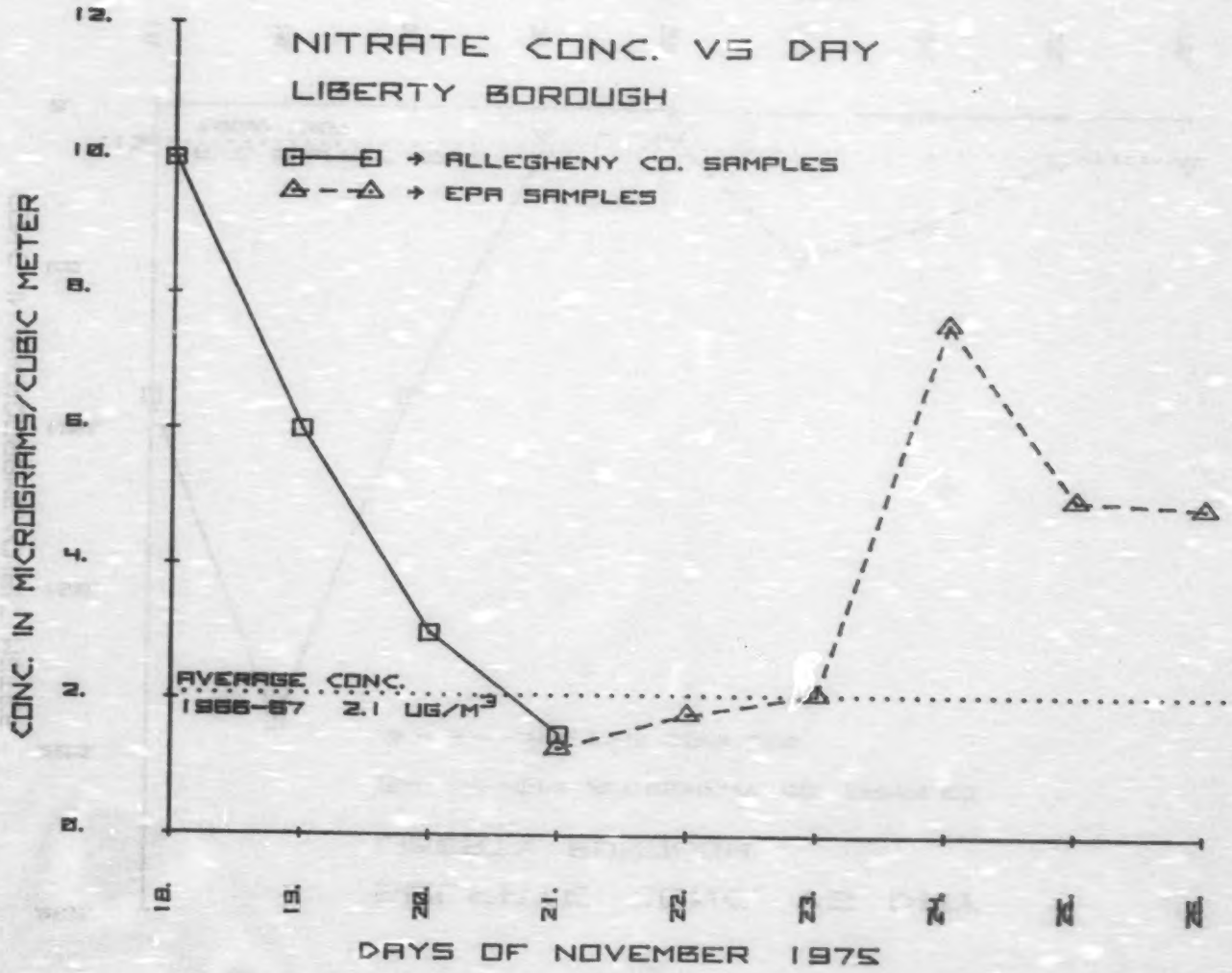
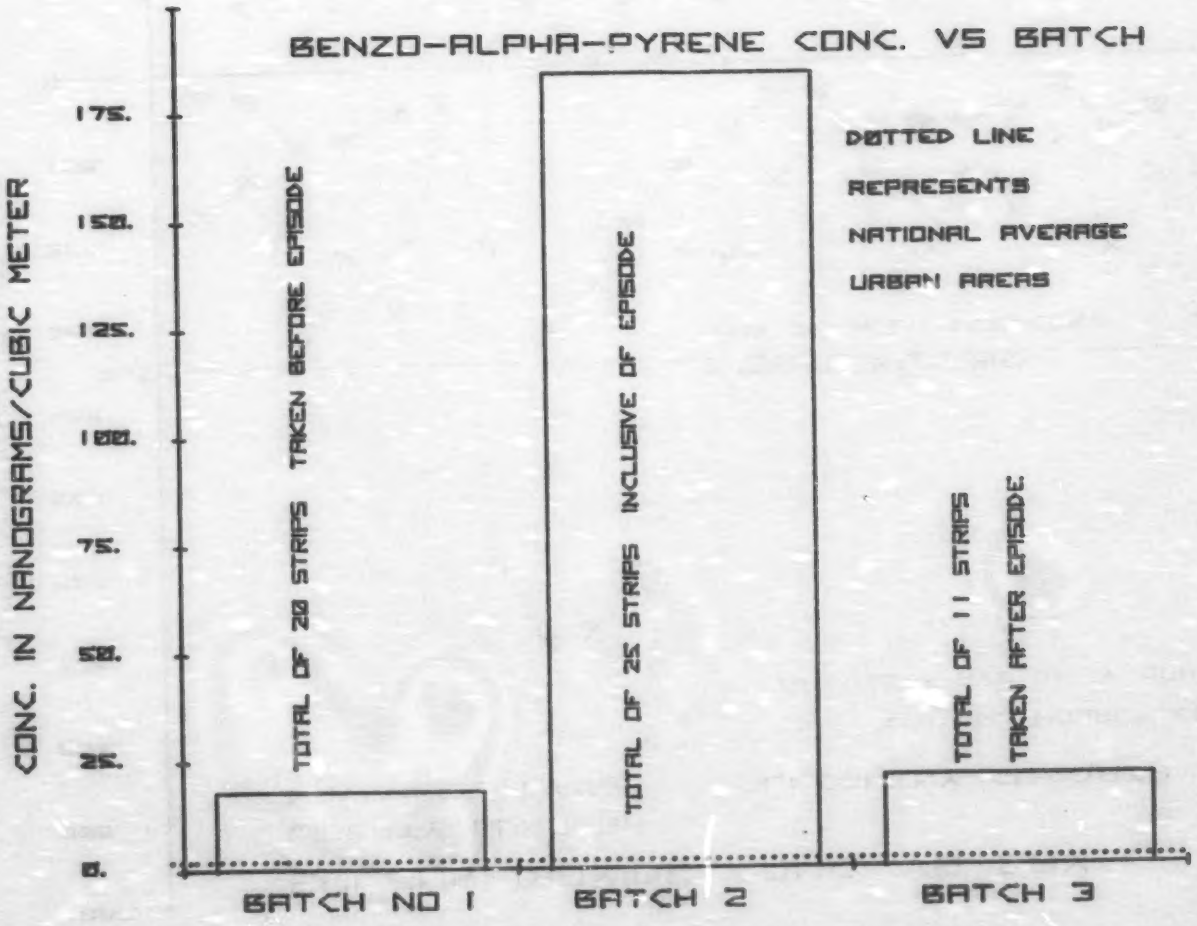
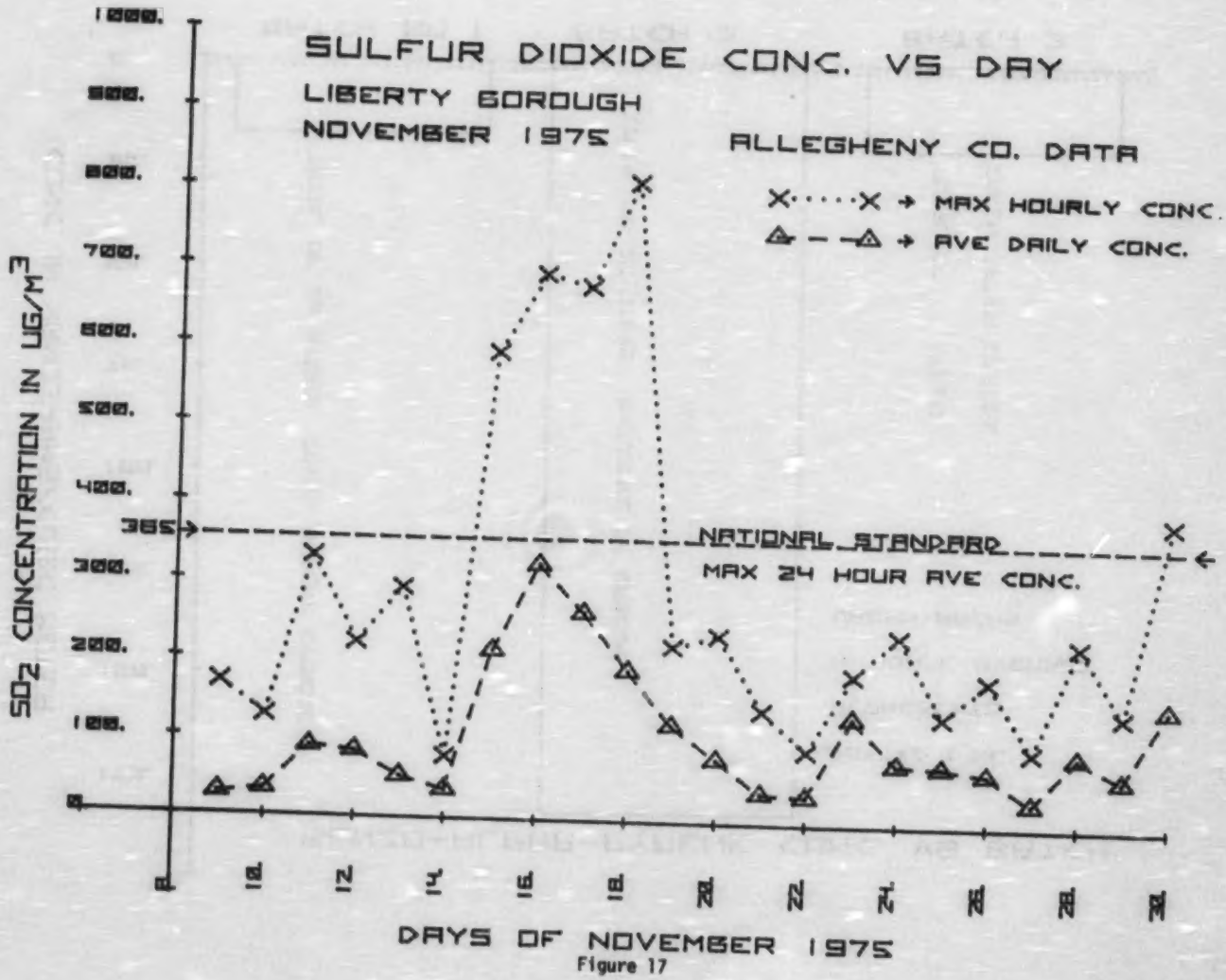

NITRATE CONC. VS DAY
LIBERTY BOROUGH
→ ALLEGHENY CO. SAMPLES
→ EPA SAMPLES
AVERAGE CONC.
1966-67 2.1 UG/M3
CONC. IN MICROGRAMS/CUBIC METER
0.
2.
4.
6.
8.
10.
12.
18.
19.
20.
21.
22.
23.
24.
25.
26.
DAYS OF NOVEMBER 1975

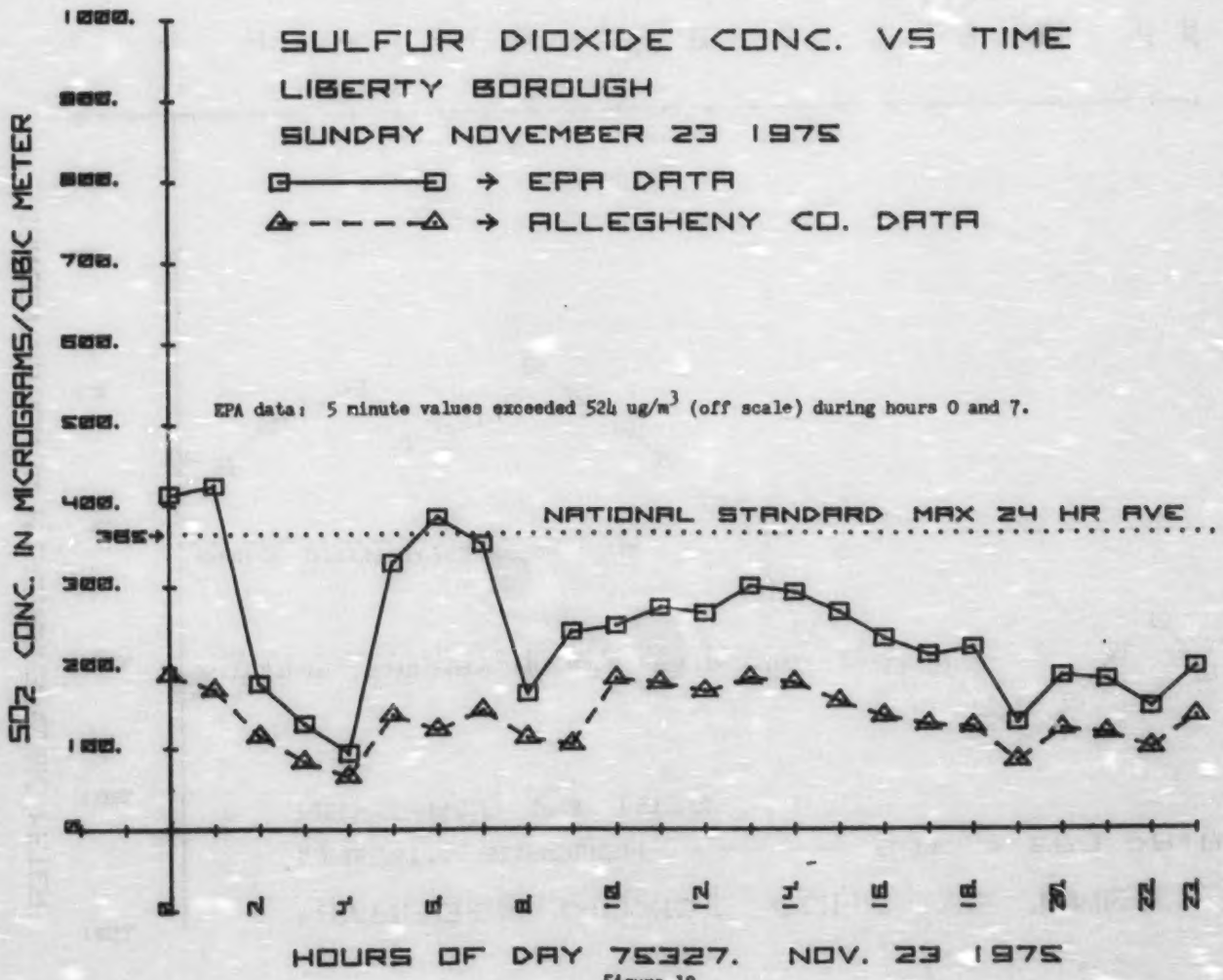
Figure 15



Samples were taken from 12 sites located in and around the city of Pittsburgh

Figure 16


SULFUR DIOXIDE CONC. VS DAY
LIBERTY BOROUGH
NOVEMBER 1975
ALLEGHENY CO. DATA
X·····X → MAX HOURLY CONC.
△ — △ → AVE DAILY CONC.
NATIONAL STANDARD
MAX 24 HOUR AVE CONC.
365
SO_2 CONCENTRATION IN UG/M^3
1000.
900.
800.
700.
600.
500.
400.
300.
200.
100.
0
10
12
14
16
18
20
22
24
26
28
30
DAYS OF NOVEMBER 1975
Figure 17


SULFUR DIOXIDE CONC. VS TIME
LIBERTY BOROUGH
SUNDAY NOVEMBER 23 1975
→ EPA DATA
→ ALLEGHENY CO. DATA
EPA data: 5 minute values exceeded 524 ug/m3 (off scale) during hours 0 and 7.
NATIONAL STANDARD MAX 24 HR AVE
365
SO2 CONC. IN MICROGRAMS/CUBIC METER
1000.
900.
800.
700.
600.
500.
400.
300.
200.
100.
0.
0
2
4
6
8
10
12
14
16
18
20
22
24
HOURS OF DAY 75327. NOV. 23 1975
Figure 18

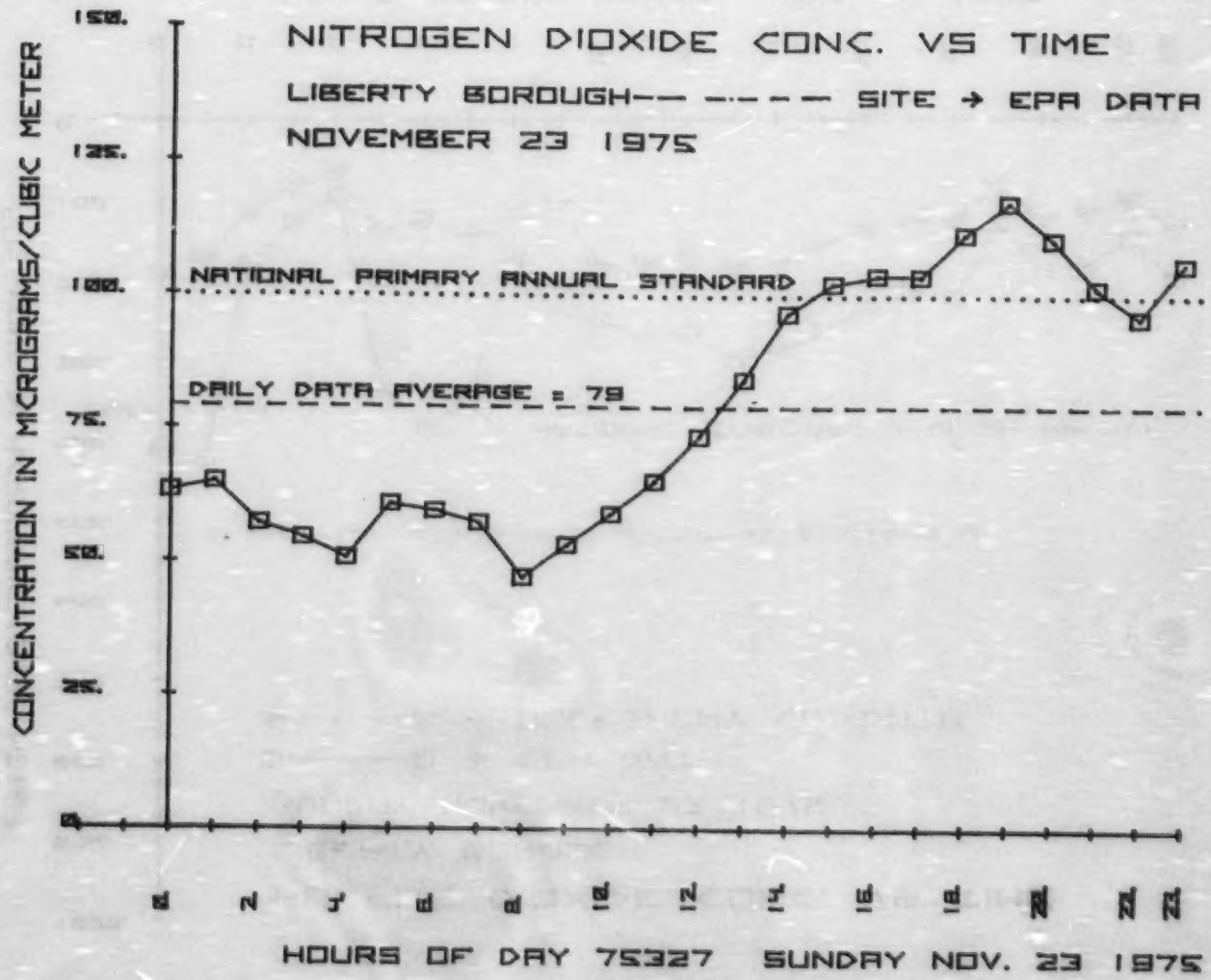

NITROGEN DIOXIDE CONC. VS TIME
LIBERTY BOROUGH-- -.-- -- SITE → EPA DATA
NOVEMBER 23 1975
NATIONAL PRIMARY ANNUAL STANDARD
DAILY DATA AVERAGE = 79
CONCENTRATION IN MICROGRAMS/CUBIC METER
150.
125.
100.
75.
50.
25.
0.
0 2 4 6 8 10 12 14 16 18 20 22 24
HOURS OF DAY 75327 SUNDAY NOV. 23 1975

Figure 19

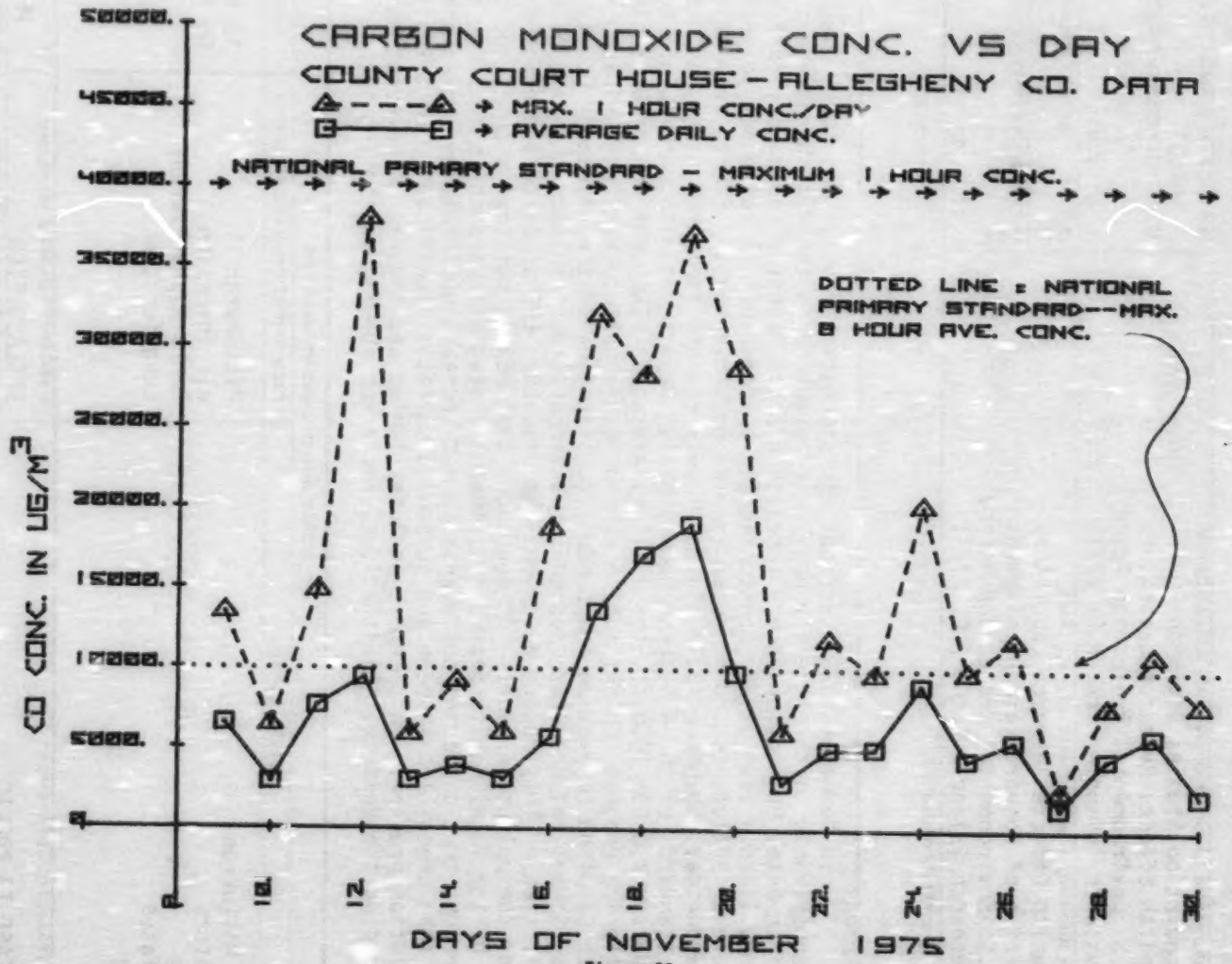

CARBON MONOXIDE CONC. VS DAY
COUNTY COURT HOUSE - ALLEGHENY CO. DATA
→ MAX. 1 HOUR CONC./DAY
→ AVERAGE DAILY CONC.
NATIONAL PRIMARY STANDARD - MAXIMUM 1 HOUR CONC.
DOTTED LINE = NATIONAL PRIMARY STANDARD--MAX. 8 HOUR AVE. CONC.
CO CONC. IN UG/M3
50000.
45000.
40000.
35000.
30000.
25000.
20000.
15000.
10000.
5000.
0.
10.
12.
14.
16.
18.
20.
22.
24.
26.
28.
30.
DAYS OF NOVEMBER 1975

Figure 20